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Learned Helplessness: Effects of stimulus-reinforcement contingencies and retention intervals.

by

© William J. Koch

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF Master of Arts

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To my parents,

who can now say "At last!" rather than "When?"

ABSTRACT

The theoretical position most closely associated with the learned helplessness phenomenon, that of Seligman (Maier & Seligman, 1976), requires organisms to recognize different degrees of contingency or noncontingency between environmental events. This position also suggests that some cognitive state, rather than an emotional state, mediates the lowered responsivity associated with the learned helplessness phenomenon. Other theoretical positions suggest that some emotional state is of primary importance. Although long-term retention of the learned helplessness effect has been demonstrated with infra-humans, it has not been demonstrated with humans.

Forty males and forty females were each exposed to one of four levels of noncontingent problem solving experience and were tested on a different problem solving task at one of two retention intervals. Four conclusions are offered from the data. First, the usual learned helplessness effect was not obtained although performance decrements associated with contingency conditions did occur. Second, this decrement does not appear to be a linear function of the degree of noncontingent experience. Third, anxiety does not appear to be related to performance within the learned helplessness paradigm. Fourth, a retention interval of at least 24 hours does exist for the performance deficit demonstrated in this experiment.

A problem of comparability of the animal and human experiments in the learned helplessness literature was also discussed.

I should acknowledge all the people who pushed, pulled, and advised me through this thesis. Thanks, Bill. I will acknowledge several people who have given me companionship, friendship, and other things too naughty to mention here. Thanks to Bob, Cindy, David, Don, Layne, Linda, Norma, Pauline, Russ, Steve, and Vivian.

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Introduction

The degree to which one can control one's own experience has recently become a popular topic in psychological research. An example of this concern is the vast amount of research and theory pertaining to the learned helplessness phenomenon. The learned helplessness phenomenon has been described as a decrement in instrumental responding associated with prior noncontingent experiences (Maier & Seligman, 1976). These noncontingent experiences have usually been of an aversive nature such as electric shock (Baker, 1976; Dinsmoor & Campbell, 1956; McCulloch & Bruner, 1939; Overmeir & Seligman, 1967; Seligman & Maier, 1967, and Seligman, Rosellini, & Kozak, 1975), aversive noise (Cole & Coyne, 1977; Hiroto, 1974; Hiroto & Seligman, 1975; Klein & Seligman, 1976; and Miller & Seligman, 1975) or failure to solve a discrimination or problem solving task (Bainbridge, 1973; Benson & Kennelly, 1976; Douglas & Anisman, 1975; Dweck & Reppucci, 1973; Hiroto & Seligman, 1975; Jones, Nation & Massad, 1977; and Tennen & Eller, 1977). Maier and Seligman (1976) have characterized all of the various learned helplessness paradigms as involving manipulations of the degree of control possessed by the organism over his environment. Aspects of this phenomenon that have been investigated are transfer of training across different response classes or tasks (Hiroto & Seligman, 1975), transfer across different aversive sources of motivation (Rossellini & Seligman, 1975), mitigation of the learned helplessness effect by prior response contingent training on a similar task to that which will later be presented with noncontingent consequences (Jones, Nation & Massad, 1977; Seligman & Maier, 1967, and Seligman, Rosellini, & Kozak, 1975), situational specificity of the learned helplessness effect (Cole &

Coyne, 1977), and retention over time (Bainbridge, 1973; Seligman, Rosellini, & Kozak, 1975).

The problem of greatest importance is the nature of the mediating variable for this general decrement in both performance and acquisition of skill on various tasks associated with prior failure at some instrumental task. Explanations for the learned helplessness effect have proliferated. Within animal research, the learned helplessness deficit has been considered to be an effect of punishing all responding so that the organism learns to suppress broad classes of behavior (see e.g. Bracewell & Black, 1974). Other authors have interpreted the phenomenon in animals to reflect the learning of active responses during the noncontingent training phase that are later incompatible with task performance (see e.g. Levis, 1976). Two other hypotheses have more relevance to research with humans and are important for the present research. These will be called the arousal mediation and the associative deficit hypotheses.

Arousal Mediation Hypotheses

There are some reasons for believing that the learned helplessness effect may be mediated by some form of physiological arousal. Weiss and his colleagues (e.g. Weiss, Glazer, & Pohorecky, 1975) have shown that certain parameters of the learned helplessness paradigm induce stress reactions in the rat that result in norepinephrine depletion and a reduction in the motor activity necessary to respond in an avoidance/escape task. Three problems arise for this hypothesis if it is to explain all instances of the learned helplessness phenomenon. First, it requires that stress inducing levels of shock or some other aversive stimulus be used to obtain the deficit. Baker (1976)

obtained the effect with a very mild (0.24 mA) shock. Second, this hypothesis could not predict decrements in passive avoidance. Baker (1976) showed such decrements. Third, it predicts a short retention of the effect because norepinephrine is produced rapidly. Seligman, Rosellini, and Kozak (1975) have demonstrated one week retention.

Other writers have suggested that physiological arousal, labeled by the subject as anxiety, may mediate the learned helplessness effect in humans (Mandler, 1972) or have explained their results as due to "frustration" (Maier, 1946). Only a few writers have shown empirically that the availability of avoidance responses seems to reduce arousal or anxiety. Thus, the availability of an avoidance response has been shown to reduce systolic blood pressure (Hokanson, DeGood, Forrest, & Brittain, 1971) and galvanic skin response (Szpiler & Epstein, 1976).

No one has yet demonstrated that the learned helplessness manipulations elicit consistently higher arousal and/or anxiety in humans nor that anxiety or arousal are associated with instrumental performance within a learned helplessness paradigm. The proponents of arousal mediation explanations must show arousal or affect to be the best predictors of the learned helplessness effect.

A last word should be said concerning the arousal mediation hypothesis. Although it has been shown that the ability to avoid aversive stimulation reduces physiological arousal and anxiety, there has been no evidence that such arousal correlates with performance in the test phase of a standard learned helplessness paradigm. Thus, to support such an hypothesis one must find arousal differences between groups exposed to different proportions or amounts of noncontingent experience. Also some high correlation should exist between arousal and

anxiety and performance on whatever test task is used. Within the animal literature, the stress hypothesis of Weiss and his colleagues has been largely discounted due to the long term retention of the deficit. However, no study has demonstrated that such a deficit in humans has a retention period of over an hour or so.

Associative Deficit Hypothesis

Beginning with the interpretations of Seligman, Maier, and their associates (see e.g. Maier and Seligman, 1976), numerous explanatory devices invoking learning of noncontingencies as a mediating mechanism have flourished. Logical sophistication and theoretical significance have, of course, varied among these explanations so that only those explanations that have something to offer to the present problem and only those data that bear on these explanations will be mentioned.

Maier and Seligman (1976) stated that the organism (including humans, dogs, rats, and several other species) is capable of learning not only the probability of reinforcement given a response and the probability of reinforcement given no response but is also able to learn these probabilities conjointly. Mackintosh (1973) and Baker (1976), speaking specifically of rabbits and rats, inferred that the organisms learn correlations between response values and reinforcement values. Maier and Seligman stated that past experience with various levels of correlation between responding in general and reinforcement determine the extent to which an organism is capable of learning and responding to a new contingency. Thus, the inescapable aversive stimulation paradigms are considered to be illustrations of a zero-order response with reinforcement correlation that proactively interferes with learning a contingent relationship. The organism presumably

encodes this information in the form of an expectancy. There is now adequate data to support this basic hypothesis that such prior information is encoded cognitively.

Prior noncontingent fialure in instrumental tasks has resulted in slower recognition of stimulus patterns (Miller & Seligman, 1975), lowered expectancies of success (Feather, 1966), increased difficulty ratings of the task (Klein & Seligman, 1976), and decreased self-ratings of ability (Klein & Seligman, 1976). The Feather (1966) results are particularly important because (a) his expectancy measure is intuitively analogous to the mediating mechanism used by Maier and Seligman (1976), and (b) he found somewhat contradictory data in that no relationship existed between stated expectancies of success and actual performance at a later time. This is, of course, contrary to the hypothesis of Maier and Seligman (1976).

Dweck (1975), using children who showed maladaptive responses to failure, demonstrated that teaching the children appropriate explanations for their failure (e.g. lack of effort as opposed to lack of ability) would alleviate what she interpreted as being a learned helplessness effect. If one accepts Dweck's assumption that the maladaptive responsivity of her children resulted from some real world experience of the learned helplessness sort, then her data appear to converge with that of Klein and Seligman (1976).

Two studies have demonstrated that attitudinal variables have an effect on the learned helplessness effect. Thus, the learned helplessness effect has been shown to be associated with the subject's belief that the preexposure task was relatively simple (Douglas & Anisman, 1975) and that the preexposure task was of some personal importance to

him (Roth & Kubal, 1975).

From all of the above one can infer that the typical learned helplessness experience both affects, and is affected by people's attributions about their own abilities and the difficulty of particular tasks. The exact nature of these relationships is not known yet. Although manipulation of verbal mediators has changed performance in various tasks, it has not been demonstrated that the decrement mitigated by such cognitive change was of the usual learned helplessness nature. As well, no study has ever demonstrated that any kind of subject is capable of showing different amounts of learned helplessness as a function of differing amounts of exposure to noncontingent experience. If the associative deficit hypothesis is to be supported in its entirety, it must be shown that groups exposed to differing degrees or amounts of noncontingent experiences have differing degrees of performance deficit. Thus, there should be a linear relation between proportion or amount of noncontingent experience and subsequent performance.

The purposes of the present study were to assess (1) whether the learned helplessness effect is related more to arousal or to expectancy of success, (2) whether different proportions of noncontingent experience actually have different effects on later performance, and (3) whether the learned helplessness effect is retained for any substantial length of time. Thus, subjects were exposed to one of three different proportions of noncontingent failure experience, tested at one of two retention intervals, and given measures of anxiety and expectancy of success.

There are five experimental hypotheses.

1. Differing proportions of noncontingent experience in a problem solving task are associated with differential performance on a later

problem solving task. Thus, the 0 percent contingent feedback group was expected to show poorer performance than the 50 percent group, which was expected to show poorer performance than the 100 percent group.

2. Expectancy of success is associated with proportion of noncontingent experience and with performance on the test task.

3. Increases in anxiety are associated with the presence of any amount of noncontingent experience.

4. Expectancy of success is more closely related to performance on the test task than is anxiety.

5. The differential effects of noncontingent experience are associated with test phase performance even with a 24 hour retention interval between preexposure and test phase.

Method

Design. The design of this study was a two (preexposure to test phase interval) X four (percent and frequency of noncontingent failure on preexposure task) X two (sex of subject) factorial design. See Table 1 for the design. The labels 100-10, 50-10, 50-20, and 0-10 refer to the proportion of trials on which contingent feedback is given to each subject and the total number of trials of concept learning given to each subject. In short, 20 subjects received 10 trials with 100 percent contingent feedback, 20 more received 10 trials with 50 percent contingent feedback, 20 more received 20 trials with 50 percent contingent feedback, and another 20 received 10 trials with 0 percent contingent feedback.

Subjects. Forty-five male and forty-eight female students at the University of Alberta participated in the experiment as part of an introductory psychology course requirement. All subjects were between 17

		100-10	50-10	50-20	0-10
0 Days Retention	Males				
	Females				
1 Day Retention	Males				
	Females				

Table 1. Description of the experimental design including two levels of retention intervals, four levels of contingency of feedback, and sex of subject as factors.

and 35 years of age, inclusive, and were native English speakers. The data from four males and four females were discarded because they were either totally confused as to the requirements of one or both experimental tasks or failed to meet the criterion for concept learning performance, i.e. learning the first concept in those conditions where learning of a specific concept was possible. Problems with this latter discard criterion will be discussed later. One male and one female were discarded because of experimental errors. One female subject failed to cooperate while another female began crying during the concept learning task so that the session was terminated early. The data from both of these subjects were discarded. One female subject was discarded because of her unusually high trait anxiety score which distinguished her from all other subjects.

The remaining 40 males and 40 females were assigned equally into the eight experimental groups, five members of each sex in each group. The mean age of these males was 20.28 years (sd=2.47) while that of the females was also 20.28 years (sd=2.87). The mean ages were also quite similar among experimental groups, ranging from 19.3 years to 21.2 years.

Materials. Preexposure stimuli consisted of sixteen 10-centimeter by 15-centimeter white cards, each of which contained a unique set of two figures. These figures represented all possible combinations of the following: either the letter "A" or "T" in either capital or small character, with either the number 1 or the number 5 located above or below the letter. See Appendix 1 for a full list of the stimuli as presented to the subjects.

The State-Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushene,

1970) was administered immediately preceding the test phase. This psychometric test measures two dimensions of human emotion known as "State" and "Trait" anxiety. Each dimension is tested by means of a 20 item true-false test. The total 40 item test can be completed in approximately five minutes. The "State" half of the test was administered prior to the "Trait" half, as suggested by the test authors.

Both A-Trait and A-State scales have high internal consistency which are even higher when subjects are under stress (Spielberger et al, 1970). The A-Trait scale shows test-retest reliabilities ranging from .73 to .86 (Spielberger et al, 1970).

The A-Trait scale has concurrent validity coefficients with the IPAT Anxiety Scale (Cattell & Scheier, 1963) and the Taylor Manifest Anxiety Scale (Taylor, 1953) ranging from .75 to .85 for different population groups. The A-State scale score is affected by watching stressful movies (Lazarus & Opton, 1966), relaxation training (Spielberger et al, 1970), threat of receiving shock (Hodges, 1967), impending examinations (Sacha & Diesenhaus, 1969), and failure feedback (Auerbach, 1969; Hodges, 1967; McAdoo, 1969; and O'Neil, 1969). Thus, it appears that the State-Trait Anxiety Inventory should provide an adequate measure of any differential anxiety aroused by the present experimental manipulations.

A seven-point expectancy of success scale was administered to each subject prior to both the concept learning and anagram tasks. The end points on this scale were labeled "will solve all problems (anagrams)" and "will solve none of the problems (anagrams)".

Ten different random orders of noncontingent yes-no feedback were used in the preexposure phase of the experiment. These orders were

generated as random orders of the digits one (for yes) and two (for no) from a computer program as part of the APL language package at the University of Alberta Computing Services. These random orders were presented in the following sequences to the stated groups. Groups 50-10 received orders 1, 3, 5, 7, and 9. Groups 50-20 and 0-10 received orders 1, 3, 5, 7, 9, 3, 4, 6, 8, and 10. This method of sequencing meant that all groups receiving noncontingent feedback received the same order of noncontingent feedback for their first five noncontingent trials. The 50-20 and 0-10 groups, although receiving different numbers of total trials of concept learning, received the same number and order of noncontingent feedback because of this procedure. For the specific orders, see Appendix 2.

Fifteen single-solution, five letter anagrams were taken from Tresselt and Mayzner (1966). The anagrams were presented individually on white cards measuring 5 centimeters by 7.5 centimeters. See Appendix 3 for the order of presentation and specific details concerning the anagrams. Anagram solution times were recorded via a hand-held stopwatch.

Procedure. All subjects were run individually. When each subject entered the experimental room, he or she was told that he/she was to participate in a problem solving experiment the purpose of which was to determine, for subjects in general, the speed and efficiency of problem solving and the transfer of training between different kinds of problems. The experimenter then read specific instructions to each subject.

> The first task is one in which you must learn a concept. The concept consists of some value of one or more of the stimulus dimensions to be shown to you as well as the rule for putting multiple dimensions into the same concept. I will explain later

just what concepts, values, dimensions, and rules are in this context. The task will begin when I show you a card containing some stimuli. You should arbitrarily guess whether that card is or is not an example of the concept I have in mind. You will say either yes or no and I will give you feedback as to whether you were correct in guessing yes, it is an example of the concept or no, it is not. I will then continue presenting cards and you will continue guessing but should, if you are attempting to solve the problem, be doing it with more information in hand, because you will be eliminating possibilities as you go. I will stop at a pre-arranged point and you must at that time attempt to describe the concept.

Now I will explain the special terms used. First, a dimension is a way something can differ between two instances or change over time. Dimensions can be constructed arbitrarily so that goodness-badness is as much a dimension as blackness-whiteness if I define them as such. A value is any specific instance of a dimension. For example, black might be one value and white another value of the blackness-whiteness dimension. You will be working with four dimensions in the concept learning task. To make the task easier, each dimension will have only two values so that, for instance, there would be no shades of gray between black and white in our example dimension. You will come to learn what the dimensions and their values are during the experiment. A rule is a way of expressing how one makes a decision for any specific card when more than one dimension is at leat partially active in the concept. Finally, a concept is merely the value or values which determine when I say yes in response to your guesses during this task. All concepts in this experiment can be described in terms of the physical characteristics of the stimuli. I am not interested in your verbal creativity.

Because there are four dimensions with two values each, sixteen cards are needed to show all possible combinations. I will show you all sixteen cards and after I show you the sixteenth card, I will ask you to describe the concept. If you do it accurately, we will proceed to the next concept. If you do not describe the concept accurately, we will go through the cards once more to see if you can learn it after more training. Do you understand?

Questions were answered by paraphrasing the appropriate part of the instructions. When any questions were answered, the experimenter administered an expectancy of success scale.

Now, before we start, I would like you to mark on this scale how well you think you will do on this task. This is done for purposes of equating our subjects so that we can reduce any

large variation in problem solving ability between subjects.

Each subject then received 10 or 20 trials of concept learning training, each trial consisting of one full cycle of 16 cards, if the subject learned on one trial, or two full cycles, if he or she did not (could not) learn on one trial. Thirty second pauses occurred between trials.

Percent contingent feedback was varied by trials. The two 0% contingent groups received prearranged random feedback (orders 1, 3, 5, 7, 9, 2, 4, 6, 8, & 10) on all 10 trials. The four 50% groups received prearranged random feedback on 5 of 10 and 10 of 20 trials, respectively. Contingent and noncontingent trials in these groups were alternated with a contingent trial initiating training and a noncontingent trial ending training. The random orders for these groups were 1, 3, 5, 7, and 9 and 1, 3, 5, 7, 9, 2, 4, 6, 8, and 10, respectively. The two 100% contingent groups received no random feedback.

The rationale for these specific groups was that while the 0-10, 50-10, and 100-10 groups would differ in proportion of noncontingent failure experience during the preexposure phase, they would also differ in total amount of noncontingent experience within that setting. The controls for this effect were the two 50-20 groups which had the same amount of noncontingent experience as the 0-10 groups and the same amount of contingent experience as the 100-10 groups. The proportion of noncontingent experience was the same as that for the 50-10 groups. The only problem with this control was that time spent in the preexposure task differed between groups so that groups 50-20 spent approximately one and one-half times as long in that phase as groups 0-10, twice as lone as groups 50-10 and twice as long as groups 100-10.

However, there is nothing in the experimental literature that suggests that such a variable is important within this paradigm, either theoretically or empirically. Also, the time spent in the preexposure phase was never over one hour for any condition so that fatigue should not have played any role in subjects' performance.

Following completion of the preexposure task, half of the subjects in each condition of preexposure were dismissed with a reminder of their appointment for the next day at the same time. The other half of the subjects proceeded immediately to the next part of the experiment. Before the second phase of the experiment all subjects filled out the State-Trait Anxiety Inventory. This was explained to subjects as being "another way of equating subjects to reduce variation". The State half of the inventory was always administered before the Trait half because administration of the Trait scale prior to the State scale is thought to have some influence on the State score (Spielberger et al, 1970).

Instructions for the anagram task were then read to all subjects.

> The next problem solving task I will give you involves anagrams. An anagram is a group of letters arranged in a non-meaningful way. I will show you several anagrams, one at a time, and you are to attempt to form a meaningful English word from the letters. This means that foreign words, such as those of French or Greek origin, are not legal solutions. Also, proper nouns and plurals are illegal solutions. You must use each letter in the anagram once and only once to form a word solution. There is only one word which can be made from each anagram. You will have only a short time to solve each anagram and may not use a pen or pencil to help you solve the anagrams. Remember that you must guess as little as possible so be sure of your solution before you tell me what it is. Do you have any questions?

Again, any questions were answered by paraphrasing the instructions. After any questions were answered, subjects were asked to fill out another expectancy of success scale.

> Now, I would like you to mark on this scale how well you think you will do on this particular task so that I can reduce between subjects variance on this task as well.

The experimenter then administered the 15 anagrams to the subjects one at a time for two minute maximum intervals. Anagram solution or expiration of the two minute time limit was followed immediately by presentation of the next anagram. Subjects reported their solutions verbally. If an incorrect solution was reported (i.e. a misspelled, non-meaningful, or foreign-origin word) the experimenter told the subject that the solution was not correct and the trial continued until the subject solved the anagram or ran out of time.

At the end of the anagram task, all subjects were shown the solutions for anagrams missed, debriefed as to the purpose and methods of the experiment, and given reference to the appropriate readings.

Results

Data obtained from this experiment were analyzed with a 2 X 4 X 2 analysis of variance. Significant effects of contingency were further analyzed with Duncan's Multiple Range Tests (Edwards, 1972) while significant interactions were analyzed using a Simple Effects F test for Sums (Edwards, 1972). For one dependent measure, anxiety change, the regression of anxiety change on Trait Anxiety was computed and a 2 X 4 X 2 analysis of variance was computed on the residual variance.

Prior to performing the main analysis, however, perusal of Tables 2 and 3 suggested the need to test for heterogeneity of variance among the experimental conditions. Conditions 50-20 showed very little variance whereas conditions 50-10 showed relatively great variance. Cochran's homogeneity of variance test (Kirk, 1969) was used to test the null hypothesis that heterogeneity of variance did not exist. This

		100-10		50-10		50-20		0-10	
		M	F	M	F	M	F	M	F
0 Days	$\overline{X}$	52.57	47.68	82.43	50.23	64.43	64.30	60.63	60.23
	SD	12.90	13.94	9.96	20.86	18.86	15.13	11.44	19.34
1 Day	$\overline{X}$	55.23	49.28	81.08	54.93	67.27	68.49	55.40	63.44
	SD	29.71	10.09	19.48	25.21	7.98	5.06	19.46	20.70

Table 2a. Means and standard deviations for each of the experimental conditions on the dependent measure, latency of solution. N equals five subjects per cell.

		100-10	50-10	50-20	0-10
0 Days	$\overline{X}$	50.13	66.33	64.37	60.43
	SD	12.93	22.92	16.12	14.98
1 Day	$\overline{X}$	52.25	68.01	67.88	59.42
	SD	21.15	25.32	6.33	19.41

Table 2b. Means and standard deviations for each of the contingency by retention interval conditions, collapsed across sex, on the dependent measure, latency of solution. N equals 10 subjects per cell.

	100-10	50-10	50-20	0-10
$\overline{X}$	51.19	67.17	66.12	59.92
SD	17.10	23.52	12.05	16.88

Table 2c. Means and standard deviations for each of the contingency conditions, collapsed across sex and retention intervals, on the dependent measure, latency of solution. N equals 20 subjects per cell.

		100-10		50-10		50-20		0-10	
		M	F	M	F	M	F	M	F
0 days	$\overline{X}$	11.40	12.00	6.20	10.80	10.00	9.60	10.40	10.00
	SD	1.34	4.00	1.92	2.59	2.45	1.82	1.82	2.74
1 Day	$\overline{X}$	10.00	11.20	7.40	10.00	9.20	9.60	10.40	9.80
	SD	4.00	1.48	3.71	3.81	1.10	1.52	2.50	2.17

Table 3a. Means and standard deviation for each of the experimental conditions on the dependent measure, number of anagram solution. N equal five subjects per cell.

		100-10	50-10	50-20	0-10
0 days	$\overline{X}$	11.70	8.50	9.80	10.20
	SD	1.64	3.24	2.04	2.20
	$\overline{X}$	10.60	8.70	9.40	10.10
	SD	2.91	3.80	1.26	2.23

Table 3b. Means and standard deviations for each of the contingency by retention interval conditions, collapsed across sex, on the dependent measure, number of anagram solutions. N equals 10 subjects per cell.

	100-10	50-10	50-20	0-10
$\overline{X}$	11.15	8.60	9.60	10.15
SD	2.37	3.44	1.67	2.16

Table 3c. Means and standard deviations for each of the contingency conditions, collapsed across sex and retention intervals, on the dependent measure, number of anagram solutions. N equals 20 subjects per cell.

null hypothesis was rejected but only when subjects were pooled across sex and retention intervals. Conditions 50-10 accounted for a significantly high proportion of the pooled variance for both dependent measures of latency of solution ($C = .43$, $df = 4, 19$, $p < .05$) and number of anagrams solved ($C = .47$, $df = 4, 19$, $p < .05$). Because significance is only reached when data are pooled across sex and retention intervals, consideration of the Duncan's Multiple Range Test should be all that is influenced by heterogeneity of variance. Edwards (1972) stated that if the number of subjects (n) is identical in all cells and is sufficiently large, the F test should be relatively unaffected by heterogeneity of variance. Although all cells are of equal size in this experiment, n is not of the size cited by Edwards as necessary to eliminate consideration of heterogeneity of variance. Boneau (1960) stated that for unequal variances but equal sample sizes the probability of obtaining a value in the 5% critical region will vary between 5.55% and 7.42% depending on the differences between the variances, sample sizes, and number of samples. Given that n equals 20 in the present pooled groups, the probability of obtaining a critical value by chance should be less than 6% at the 5% level of significance. Thus, it does not seem reasonable to worry about the present heterogeneity of variance and its effect on the Duncan's Multiple Range Test results.

The analysis of variance on the latency of solution measure (see Table 4) showed two significant F values and a trend toward a main effect of another factor. The data demonstrate a significant effect of the contingency manipulations on latency ($F = 3.40$, $df = 3, 63$, $p < .023$), a trend toward a main effect of sex ($F = 3.65$, $df = 1, 63$, $p < .06$),

Source of Variation	Sum of Squares	DF	Mean Square	F	P
Total	27,410.94	79	346.97		
Contingency	3,153.68	3	1,051.23	3.40	.023
Retention	49.73	1	49.73	.16	
Sex	1,137.37	1	1,137.37	3.68	.060
Contingency X Retention	53.07	3	17.69	.06	
Contingency X Sex	3,318.45	3	1,106.15	3.58	.019
Retention X Sex	67.34	1	67.34	.22	
Contingency X Retention X Sex	70.95	3	34.65	.08	
Residual	19,490.62	63	309.38		

Table 4. Analysis of Variance summary table for a 2 X 4 X 2 analysis on the dependent measure of anagram solution latency.

Conditions	100-10	50-10	50-20	0-10
$\bar{X}$	51.19ab	63.67a	64.62b	59.92

Table 5. Mean latency of anagram solution scores for contingency conditions and the results of a Duncan's Multiple Range Test. N equals 20 per condition. Means with the same subscript are significantly different ($p < .05$).

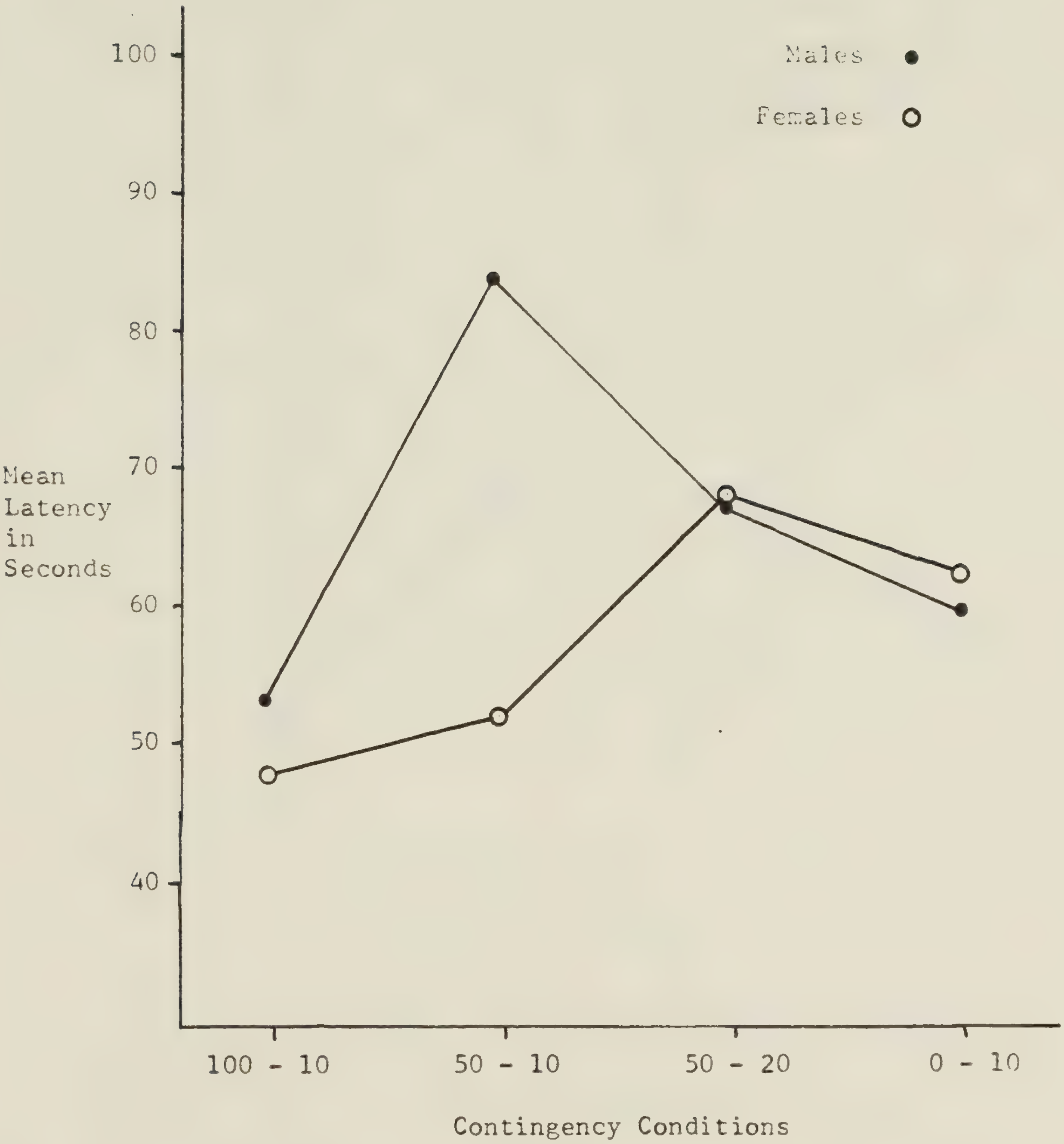

Figure 1. Mean latencies to solve anagrams. Comparison of males and females across different contingency conditions, collapsed across retention intervals. Ten subjects per condition.

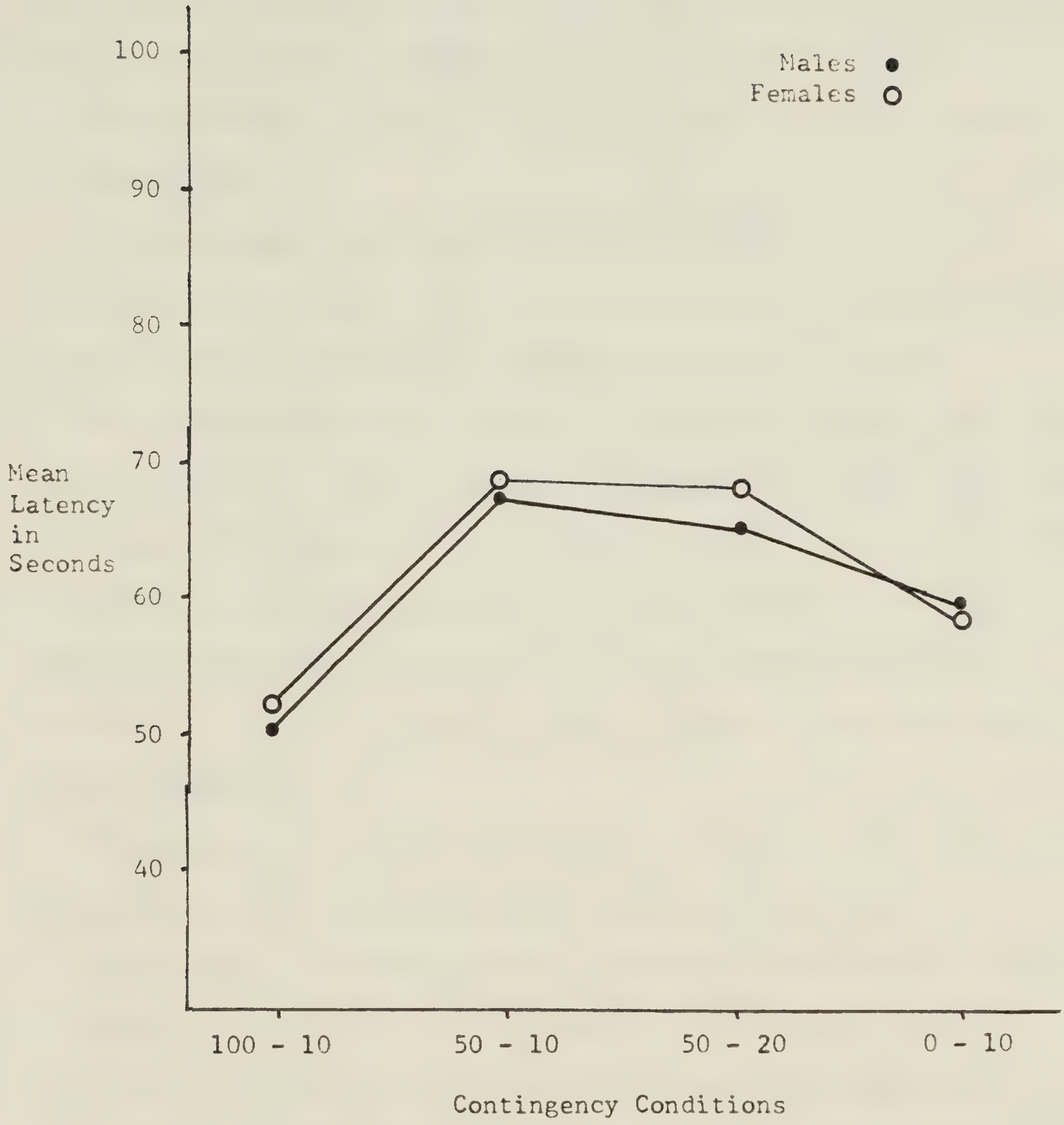

Figure 2. Mean latency to solve anagrams. Comparison of the two retention intervals across contingency conditions, collapsed across sex of subject. Ten subjects per condition.

and a significant interaction of contingency and sex of subject ($F = 3.56$, $df = 3.63$, $p < .019$). The Duncan's Multiple Range Test demonstrated that the effect of contingency is the result of groups 100-10 solving anagrams in significantly less time than any of groups 50-10 ($r = 3$, $df = 63$, difference = 12,48, $p < .05$) and 50-20 ($r = 4$, $df = 63$, difference - 13.43, $p < .05$). See Table 5 for the results of this analysis.

As can be seen from Figure 1 the trend toward an effect of sex on latency of solution is the product of seemingly slower anagram solution by the males in the 50-10 conditions than by the females.

The Simple Effects test showed the contingency by sex interaction to be a product of, first, a greater difference between the 100-10 and 50-10 groups for males than for females ($F = 4.55$, $df = 1,63$, $p < .05$), and second, a sharp decrease in latency from conditions 50-10 to conditions 50-20 for males as opposed to a sharp increase in latency for females ($F = 7.13$, $df = 1, 63$, $p < .01$). Figure 1 illustrates both effects dramatically.

There was no effect of retention ($F = .15$, $df = 1.63$). This is illustrated by the virtually identical curves in Figure 2.

The analysis of variance on the other performance measure, number of anagram solutions (see Table 6) showed a significant effect of contingency ($F = 3.48$, $df = 3.63$, $p < .021$) and trends toward an effect of sex of subject ($F = 3.34$, $df = 1, 63$, $p < .072$) and a contingency X sex interaction ($F = 2.72$, $df = 3, 63$, $p < .052$).

The Duncan's Multiple Range Test demonstrated that the effect of contingency is the result of groups 100-10 solving significantly more anagrams than groups 50-10 ($r = 4$, $df = 63$, difference = 2.55, $p < .01$).

Source of Variation	Sum of Squares	DF	Mean Square	F	P
Total	570.74	79	6.85		
Contingency	63.71	3	21.24	3.45	.022
Retention	2.67	1	2.67	0.43	.07
Sex	21.01	1	21.01	3.41	
Contingency X Retention	3.77	3	1.26	0.20	
Contingency X Sex	50.30	3	16.77	2.72	.05
Retention X Sex	.11	1	.11	0.02	
Contingency X Retention X Sex	5.87	3	1.96	0.32	
Residual	388.22	63	6.16		

Table 6. Analysis of variance summary table for a 2 X 4 X 2 analysis on the dependent measure of number of anagram solutions.

Conditions	100-10	50-10	50-20	0-10
$\bar{X}$	11.15a	8.60a	9.60	10.15

Table 7. Mean number of anagram solutions for contingency conditions and the results of a Duncan's Multiple Range Test. N equals 20 per condition. Means with the same subscript are significantly different ($p < .01$).

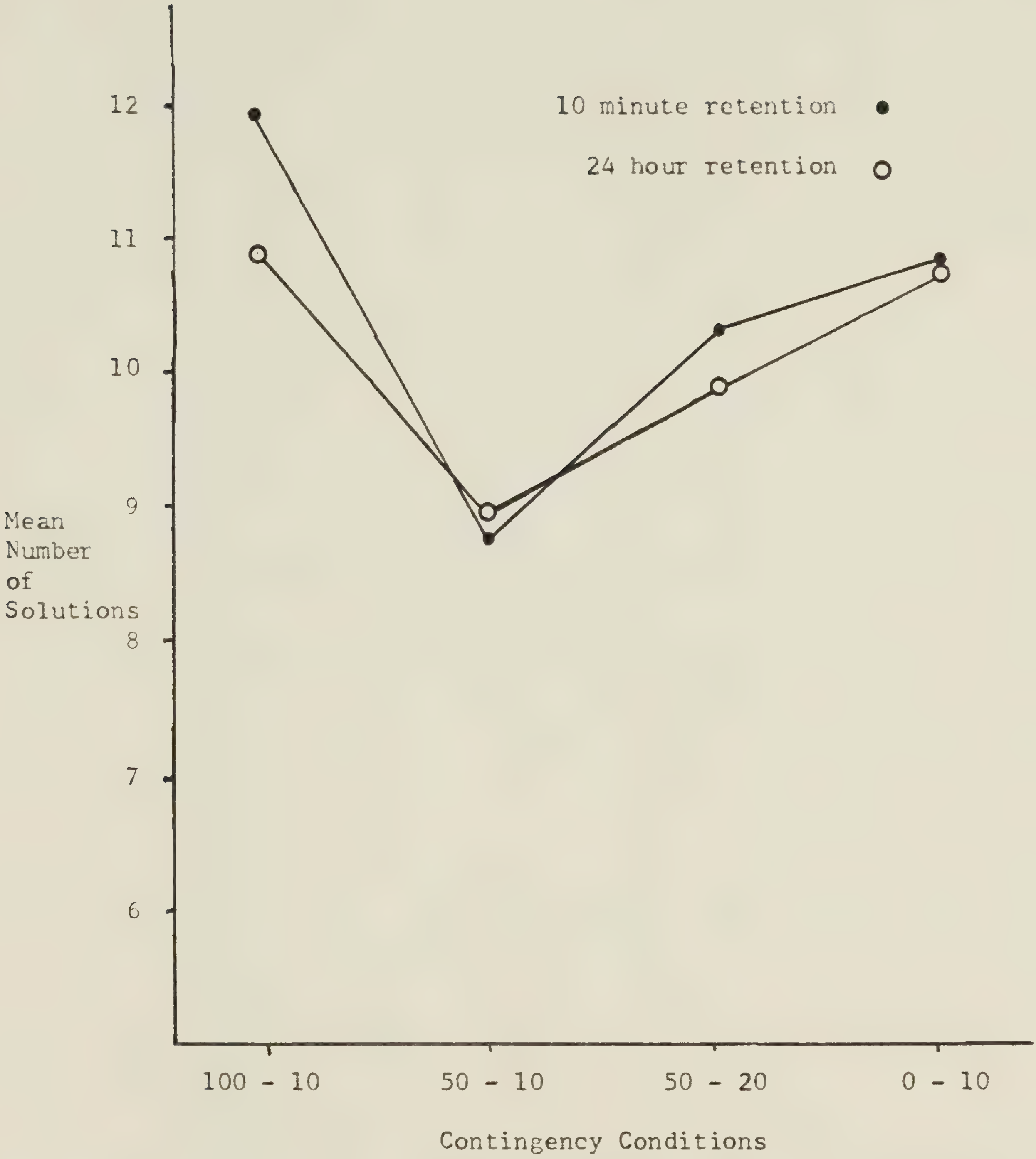

Figure 3. Mean number of anagram solutions. Comparison of the two retention intervals across contingency conditions, collapsed across sex of subject. Ten subjects per condition.

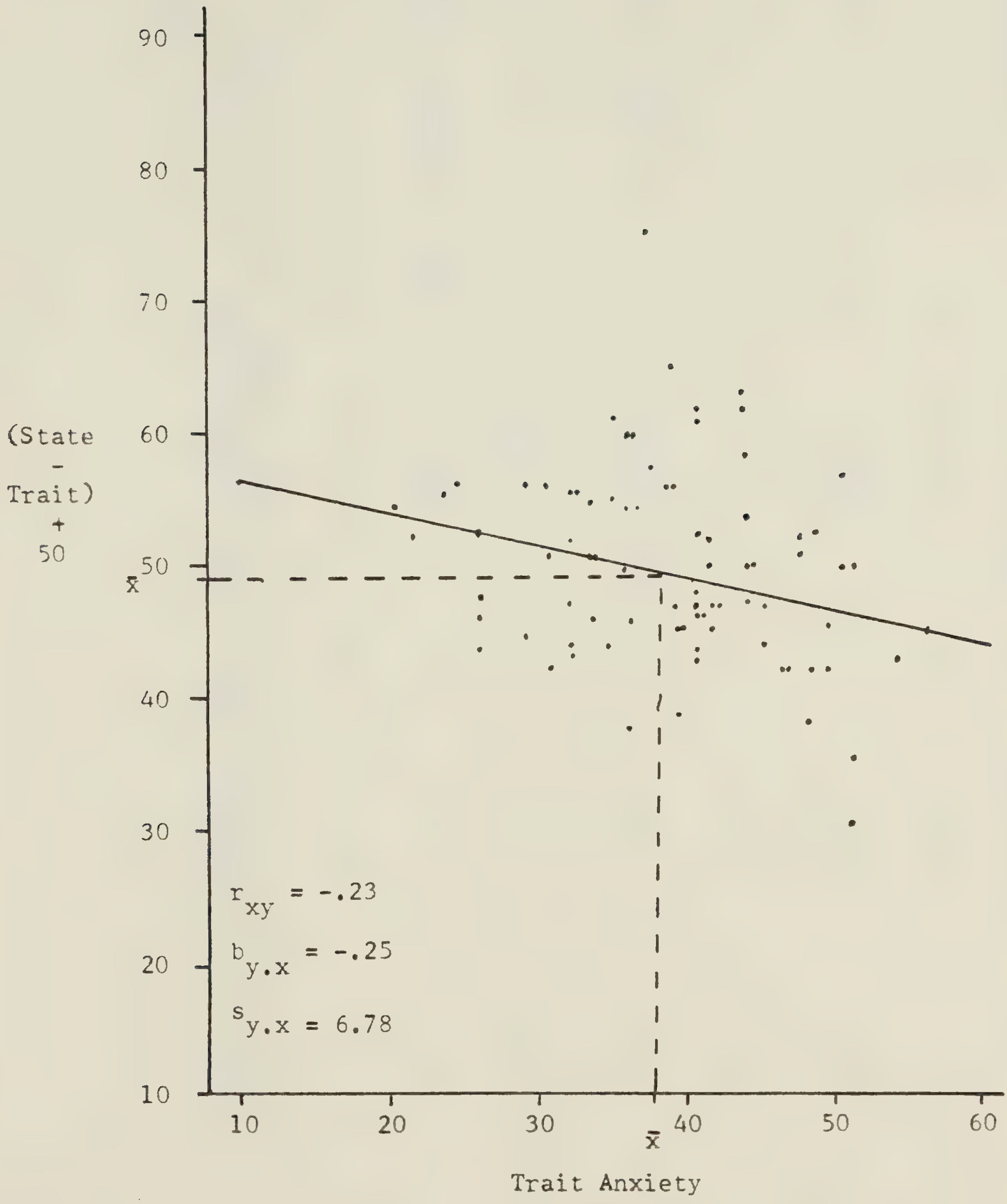

Figure 4. The linear regression of the anxiety change measure on Trait Anxiety and all data points for all eight experimental conditions.

Source of Variation	Sum of Squares	DF	Mean Square	F	P
Total	3,999.27	79	50.62		
Contingency	231.10	3	77.03	1.88	
Retention	413.32	1	413.32	10.06	.002
Sex	60.44	1	60.44	1.47	
Contingency X Retention	354.51	3	118.18	2.88	.042
Contingency X Sex	119.23	3	39.74	.98	
Retention X Sex	160.87	1	160.87	3.92	.052
Contingency X Retention X Sex	80.89	3	26.96	.66	
Residual	2,487.23	63	41.07		

Table 8. Analysis of variance summary table for a 2 X 4 X 2 analysis on the dependent measure of (State Anxiety - Trait Anxiety) + 50. Variance attributable to the linear regression of the anxiety measure on Trait Anxiety was subtracted from the total and residual sum of squares.

See Table 7 for details.

The trend toward a sex effect on number of solutions suggest the same phenomenon as does that trend on the latency measure, that females may be better anagram solvers than males. The trend toward a contingency by sex interaction for number of solutions appears similar to the significant interaction for the latency measure mentioned above. Again, no effect of retention on number of solutions was found ($F = .42$, $df = 1, 63$). See Figure 3 to compare retention interval data.

The measure used to assess anxiety changes associated with experimental experience was a difference score added to a constant. Each subject's Trait Anxiety score was subtracted from his or her State Anxiety score and a constant of 50 was added to the difference. This difference score was used to reduce the influence of differential levels of Trait Anxiety among subjects. The constant of 50 was used in order to make all difference scores positive.

The regression analysis of anxiety change on Trait Anxiety resulted in a regression coefficient of -.2464 with a standard error of estimate of 6.7847. See Figure 3 for the plotted regression data. The analysis of variance on this anxiety measure showed a significant effect on anxiety change for retention intervals ($F = 10.06$, $df = 1, 63$, $p < .002$), a significant contingency X retention interval interaction ($F = 2.88$, $df = 3, 63$, $p < .042$), and a trend toward an interaction of retention interval and sex of subject ($F = 3.92$, $df = 1, 63$, $p < .052$). See Table 8 for these data.

The significant effect of retention was the result of three of four contingency groups showing lower anxiety scores in the 24 hour conditions than in their respective immediate test groups. Simple

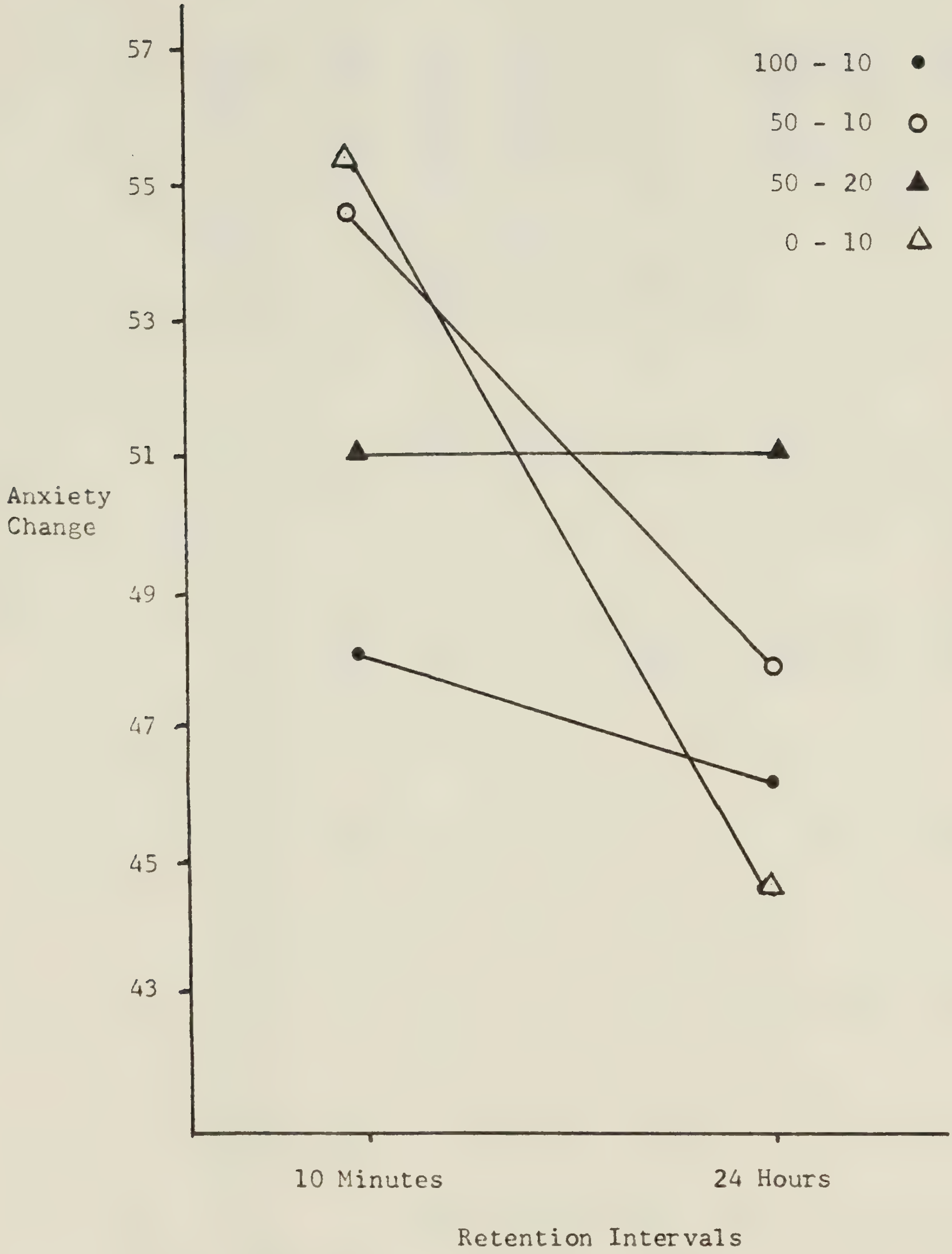

Figure 5. Anxiety change, measured as State Anxiety minus Trait Anxiety plus a constant of 50. Comparison of contingency conditions across retention intervals, collapsed across sex of subject.

Source of Variation	Sum of Squares	DF	Mean Square	F	P
Total	138.20	79	1.75		
Contingency	2.27	3	.76	.44	
Retention	1.53	1	1.53	.88	
Sex	1.17	1	1.17	.67	
Contingency X Retention	8.04	3	2.68	1.55	
Contingency X Sex	7.71	3	2.57	1.48	
Retention X Sex	4.18	1	4.18	2.41	
Contingency X Retention X Sex	.23	3	.08	.04	
Residual	113.053	63	1.79		

Table 9. Analysis of variance summary table for a 2 X 4 X 2 analysis on the dependent measure (expectancy of anagram success - expectancy of concept learning success) + 10.

effect tests showed the significant contingency X retention interval interaction to be the result of a larger difference in anxiety from the immediate test condition to the 24 hour retention condition for group 0-10 than for group 100-10 ($F = 4.15$, $df = 1,63$, $p < .05$) and of a larger difference of the same sort for group 0-10 than for group 50-20 ($F = 6.40$, $df = 1, 63$, $p < .025$). Figure 5 illustrates both the retention interval difference and the contingency X retention interval interaction.

The trend toward a retention interval X sex of subject interaction appears to reflect higher anxiety scores for males than for females in conditions 100-10 and 0-10 at the immediate test retention interval as opposed to no anxiety differences between males and females in any other conditions. The linear regression of the anxiety measure on Trait Anxiety suggests that subjects with lower Trait Anxiety show greater increases in present anxiety as a result of this experimental procedure than do subjects with higher Trait Anxiety. This relationship accounts for 5.23% of the variance in immediate anxiety scores in this experiment.

No significant effects were found for either contingency ($F = 1.92$, $df = 3, 63$) or sex ($F = 1.35$, $df = 1, 63$).

Table 9 shows the analysis of variance summary table for the expectancy of success change measure. This measure was formed by subtracting expectancy of concept learning success from expectancy of anagram success and adding a constant of 10 to that result. No significant effects were found for this dependent measure.

Post hoc analyses were suggested by research published after the conception of this study. Tennen and Eller (1977) asked subjects to rate their experience with anagrams and word puzzles on a seven-point

	State Anxiety	Expected Anagram Success
Latency to Solution	.06	-.32**
Number of Solutions	.13	.26*

*p < .01
**p < .005

Table 10. Pearson product-moment correlation coefficients for latency and number of anagram solutions measures with State Anxiety and expectancy of anagram success measures.

scale prior to the test task. The authors used this rating as a covariate with their anagram performance measures and found covariate coefficients of -.61, -.84 and -.74 with their dependent measures of latency, number of solutions, and trials to criterion, respectively.

These data suggested that the single measure, expectancy of anagram success, might be related to anagram performance within the present study. Consequently, Pearson product-moment correlations were computed for the performance measures of solution latency and number of solutions with State Anxiety and expectancy of anagram success. Table 10 illustrates the correlation coefficients obtained.

State Anxiety had no significant relationship with either performance measure. Expectancy of anagram success had significant relationships with both latency ($r = -.32$, $df = 70$, $p < .005$) and number of solutions ($r = .26$, $df = 79$, $p < .01$). This suggests that this expectancy of success measure would be an adequate, though inferior to that of Tennen and Eller, covariate for these dependent measures.

Discussion

The first major hypothesis was that the different contingency conditions would hinder later anagram performance to differing degrees. It was predicted that the 100-10 groups would show the best anagram performance, the 50-10 and 50-20 groups would perform significantly worse, and the 0-10 groups would perform least well. Although this study found effects of contingency of feedback on both anagram performance measures, the data did not conform to the hypothesis. No significant differences were found among groups 50-10, 50-20, and 0-10. In fact, the performance of groups 0-10 was better, though not significantly so, than that of groups 50-10 and 50-20. Groups 100-10 performed signifcantly

better than only groups 50-10 and 50-20 on the latency measure and better than only groups 50-10 on the number of solutions measures. Thus, groups 100-10 did not significantly outperform groups 0-10.

This result is a failure to replicate Benson and Kennelly (1976, Hiroto and Seligman (1975), and Jones, Nation, and Massad (1977), all of whom found anagram performance differences between groups exposed to completely noncontingent and completely contingent concept learning training. In all cases the test task was an anagram task similar to that used in the present study. Thus, one must conclude that a "helplessness" effect was obtained but it was not the same effect obtained by other researchers.

The possibility does exist that the completely noncontingent experience used in the present study is not comparable to that used by Benson and Kennelly (1976), Hiroto and Seligman (1974), and Jones, Nation, and Massad (1977). Two differences exist which, though theoretically trivial, may be of practical importance. First, the to be learned concepts were more complex, on the average, than those used in previous research. Whereas previous research used single-dimension concepts, the present research used a set of concepts which included 4 disjunctives and at least an equal number of conjunctives within the total set of 20 concepts. There is a possibility that the existence of these more difficult concepts could influence test phase performance in the 100 percent contingent groups thus creating a bias toward the null hypothesis. However, this unique aspect of the present research does not explain the peculiar lack of any learned helplessness effect in the 0 percent contingent groups versus the presence of that effect in the 50 percent groups.

Second, in previous research, all subjects were given, as part of the instructions, a sample concept formation problem. In the present study, all subjects were given much more detailed instructions than in the previous research but were not exposed to a sample task. Given that subjects exposed to completely noncontingent feedback in the present study never saw an actual problem soltuion for a concept formation task, they may have been unusually prone to suspect that no solutions existed, which was indeed the case. Numerous subject states and preocesses may be affected by suspicion. Attention to the task and effort extended may be affected by suspicion. Of course, if subjects are not sufficiently attentive the theoretically necessary cognitive mediation of the learned helplessness effect may not take place. If the subject's effort is affected by his suspicion, he may be more prone to attribute his failure to lack of effort or to the experimenter's manipulation than to his own lack of ability. Of course, this assumes that such mediating processes are of importance in this general paradigm. Such mediating processes may not be of any importance within the general paradigm, and so would be of no value in explaining these peculiar data. If suspicion is to explain the lack of a learned helplessness effect for the 0 percent contingent groups then whatever internal mediators are associated with suspicion must aid performance in the test task. The greatest problem with this explanation is that no evidence was obtained showing unusual suspicion rates in any conditions.

Hypothesis two was that the dependent measure of expectancy of success change would mimic the hypothesized results for the anagram performance measures. Such was not the case. No effects of contingency were found for the expectancy of success change measure. One must infer

one or both of two reasons for this failure. First, one could conclude that expectancy of future success is not affected by noncontingent failure experience. Second, one could conclude that the items used to measure expectancy of success were inadequate and did not probe the subjects' true states. That noncontingent failure experience should lead to lower expectancies of success is intuitively plausible and should be expected from the work of Feather (1966). It seems easier, and more conservative, to explain the failure of a manipulation by saying that the measuring device was inadequate than by accepting the null hypothesis on the basis of one study. Failure to support hypothesis two renders the results for hypothesis four less meaningful, as will be discussed.

In hypothesis three, it was predicted that contingency conditions would be associated with anxiety. Again, there was no main effect of contingency condition on the anxiety measure. The only significant effect that supports any hypothesis of anxiety differences between contingency groups is the contingency X retention intervals interaction which was a result of the 0-10 groups showing a greater difference in anxiety between retention intervals than the 100-10 and 50-20 groups. The interaction cited above leads one to believe that some difference in anxiety might exist between contingency conditions if it can be extracted in experiments more directly concerned with the specific problem.

Hypothesis four was that expectancy of anagram success correlates more highly with anagram performance than does State Anxiety. This hypothesis was confirmed. State Anxiety had no significant relation to either anagram performance measure while expectancy of anagram success had significant, though small, correlations with both anagram performance measures. However, the explanatory value of such a relation-

ship between expectancy of anagram success and anagram performance depended on some significant effect of contingency on expectancy of anagram success. Because of the failure to confirm hypothesis two, one cannot infer that performance differences between conditions were mediated by different expectancies of success. Note that a relation of anagram performance to prior expectancy of anagram success is incongruent with the results of Feather (1966) who found no such relation.

Hypothesis five was that no retention interval differences would be found for the anagram performance measures, i.e. the "helplessness" effect would be retained at least 24 hours. Aside from the problem that arguing for the null hypothesis is a statistically illegitimate position, this hypothesis was better supported than any other. The F values for the main effect of retention intervals were below 1.0 for both anagram performance measures. Figures 2 and 3 both show that, although differences exist between contingency conditons, virtually no differences exist between retention intervals within the same contingency condition. It appears reasonably safe to say that hypothesis five is supported and that whatever "helplessness" effect was obtained in this experiment lasts at least 24 hours.

One additional point should be made about the lack of retention interval differences on the anagram measures and the strong retention interval differences in anxiety coupled with a lack of contingency differences on the anxiety measure. If arousal were to play a part in mediating the learned helplessness effect, as proposed by some theorists (e.g. Mandler, 1972), and if arousal shows an effect of retention intervals, as the present data demonstrate, anagram performance should also show a parallel effect of retention intervals. Of course, anagram

performance does not show this effect of retention intervals. This leads one to infer that anxiety must play a very insignificant part in the learned helplessness effect obtained here and probably in the standard learned helplessness effect obtained by other investigators. The present experiment gave some unexpected results which are of some interest beyond the major hypothesis.

The first, an intuitively plausible result, was that a trend existed that suggested females are better anagram solvers than males. This finding suggests that research using a test task similar to the present one control for sex of subject or be prepared to analyze such sex differences. In this particular case the trend toward an effect of sex was particularly dependent on four males with exceedingly poor anagram performance. Four males, as opposed to zero females, had mean latency scores of over 90 seconds to solve their 15 anagrams.

Another phenomenon that needs to be discussed is the interaction of contingency and sex on anagram performance. This interaction is the result of essentially no "helplessness" effect among the females in conditions 50-10 and an extreme decrement in performance for the males in those same conditions. Again, this effect is partially due to those four males with mean latency scores above 90 seconds. Whether this is mere sampling error or an actual differential effect of the conditions is impossible to say. Sampling error appears, to this author, to be the most parsimonious and meaningful explanation. No good theoretical explanation exists which would predict a differential effect of that condition alone on different sex subjects. Thus, an explanation which has no theoretical implications seems best at this time.

The effect of retention intervals on the anxiety measure is not

surprising because State Anxiety is, by definition, a transitory phenomenon (Spielberger et al, 1970). What is surprising is the lack of any retention interval difference for groups 50-20. This seemingly odd occurrence (See Figure 4) contributed to the contingency X retention interval interaction for the anxiety measure. The most theoretically meaningful explanation would have involved all of groups 0-10, 50-10, and 50-20 showing greater retention interval differences than groups 100-10. One can only explain such an occurrence by sampling error, i.e. the possible existence of atypical subjects in the 24 hour retention group exposed to the 50-20 contingency.

The trend toward a retention interval X sex of subject interaction on the anxiety measure is another effect which does not appear in a straight forward enough manner to allow meaningful inference. If this effect had been significant, the most one could infer would be that the 0-10 condition has some idiosyncratic effect on anxiety for males which it does not have for females. THis leaves one to ponder the absence of such a sex difference in groups 50-10 and 50-20 and the presence of that difference in groups 100-10.

The significant covariation of Trait Anxiety with the anxiety measure used in this experiment does not confirm what would be intuitively plausible, that subjects with high Trait Anxiety show larger anxiety increases in a stressful situation than do subjects with low Trait Anxiety. The negative covariation coefficient suggests just the opposite. This effect is most parsimoniously explained as an effect of the measuring device and the construct of anxiety. The possibility exists that larger increases in anxiety were more possible for low Trait Anxiety subjects than for high Trait Anxiety subjects because of some kind of

"psychological" ceiling beyond which State Anxiety could not rise. Such a ceiling would produce a negative correlation given that the experiment was sufficiently stressful to increase all subjects' State Anxiety and that all other things were equal between high and low Trait Anxiety subjects.

At least three comments are required concerning the paradigm used in the present research. All these points have relevance for prior research such as Benson and Kennelly (1976), Hiroto and Seligman (1975), and Jones et al (1977). First, in the present study the criterion of discarding the data of subjects who could not learn the first soluble concept recognized the problem that not all adults can learn even the simpler unidimensional concepts. Because subjects in the completely noncontingent conditions of the learned helplessness paradigm used in this experiment are not allowed the opportunity to "learn" a concept, the experimenter had no way of recognizing subjects who could not learn a concept under any conditions. To the extent that concept learning performance and anagram solution performance are related (e.g. by some common factor of intelligence), discarding non-learners from the contingent feedback conditions will result in a liberal bias in favor of the hypothesis that noncontingent feedback later causes decrements in anagram performance. Although this criticism has little relevance for the data of the present experiment because no differences in anagram performance between groups 100-10 and 0-10 existed, it does have relevance for other research using a noncontingent exposure to a concept learning task. The best solution for this difficulty would be to have a short (one or two trials) assessment of each subject's concept learning ability prior to executing the experimental manipulations.

Second, a great deal of within groups variance existed for the anagram performance measures, as previously noted by Benson and Kennelly (1976). Those authors used a covariate of a seven point scale expressing the subject's prior experience with anagrams or word games to statistically reduce this within groups variance. This author prefers to control variance by experimental design rather than statistical manipulations and thus suggests that a pretest, using something like a multiple solution anagram, be used to block potential subjects into different ability categories. This method also allows the heuristic advantage of having another variable, anagram solving ability, to investigate within this paradigm.

One very important conceptual problem exists within many of the recent learned helplessness studies which have used a concept learning task to vary contingency of reinforcement (Benson & Kennelly, 1976; Douglas & Anisman, 1975; Dweck & Repucci, 1973; Hiroto & Seligman, 1975; Jones, Nation & Massad, 1977; and Tennen & Eller, 1977). These authors have justified their use of this paradigm because of the intuitive similarity between noncontingency of feedback and noncontingency between response and reinforcement in the animal learning literature. The Hiroto & Seligman (1975) research demonstrated that very similar behavioral deficits were associated with noncontingent reinforcement of shuttle escape from an aversive noise, and with noncontingent feedback on a concept learning task. This finding encouraged the other authors cited above to use the concept learning paradigm without giving enough thought to the important difference between the two paradigms. The typical paradigm used with animals involves an aversive stimulus that is administered to the subject with no relation to its behavior. Thus, the

contingency, or non-contingency, is between the experimenter-administered reinforcement (feedback) and the stimulus cards.

Because of this conceptual difference, one might expect very different results between studies using the two different paradigms. What these different results might be, and what different internal processes might be effected, are open to conjecture. A possibility does exist that attributions to one's own internal states or to the task might be differentially effected by these two different paradigms. Consequently, the conceptual relationship of any learned helplessness effects obtained with paradigms such as that used in the present research with the early animal learning research is in question. To show that similar behavioral deficits occur is not enough to support hypotheses of similar underlying processes. Because of the conceptual difference between the two paradigms, any failures to find a learned helplessness effect within one paradigm can not be construed as data contrary to that supporting data from the other paradigm. The inverse is also true. Data obtained from the different paradigms showing similar deficits is, at best, provocative. Such convergence can not be interpreted as concetpual replication or confirmation.

In conclusion, four things must be mentioned. First the learned helplessness phenomenon does not appear to be a linear function of the proportion of noncontingent experience to which the subject is exposed. Second, the learned helplessness phenomenon does not appear to be at all related to present anxiety as measured by the State-Trait Anxiety Inventory. The nature of the mediating process is yet to be conclusively demonstrated. Third, the learned helplessness phenomenon appears to last at least 24 hours in college students. Fourth, the above three

conclusions must be qualified because the "helplessness" effect obtained in this experiment occurred in the absence of any difference between the completely contingent and completely noncontingent conditions. Thus, the comparability of the present experiment with those of Benson and Kennelly (1976), Hiroto and Seligman (1975) and Jones et al (1977) is in question.

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A Above Left Hand

t Below Right Hand

A Below Right Hand

a Below Right Hand

T Below Left Hand

T Above Right Hand

a Above Left Hand

A Above Right Hand

a Above Right Hand

T Below Right Hand

t Above Left Hand

T Above Left Hand

a Below Left Hand

t Below Left Hand

t Above Right Hand

A Below Left Hand

Appendix 1. List of stimulus card characteristics as presented to subjects. Each line corresponds to one card. All subjects saw the same order of cards.

Stimulus Card Presentation	List 1	List 2	List 3	List 4	List 5
1	no	yes	yes	yes	yes
2	yes	yes	yes	no	no
3	yes	yes	no	no	yes
4	yes	no	yes	yes	no
5	yes	no	yes	yes	yes
6	yes	yes	no	no	no
7	no	yes	yes	no	yes
8	no	yes	no	yes	yes
9	yes	no	yes	no	yes
10	yes	yes	no	yes	no
11	no	no	yes	yes	no
12	yes	no	yes	yes	yes
13	no	no	no	yes	no
14	yes	no	yes	yes	no
15	yes	yes	yes	yes	no
16	no	no	yes	no	yes

Stimulus Card Presentation	List 6	List 7	List 8	List 9	List 10
1	no	no	yes	no	no
2	no	no	no	no	no
3	yes	no	no	no	yes
4	yes	yes	no	no	yes
5	yes	no	no	yes	no
6	yes	no	no	no	no
7	yes	yes	no	yes	yes
8	yes	yes	no	no	no
9	yes	yes	yes	yes	yes
10	no	yes	yes	yes	no
11	no	no	no	no	yes
12	no	no	no	yes	yes
13	no	yes	no	no	yes
14	yes	yes	yes	no	yes
15	yes	no	yes	yes	no
16	no	no	yes	yes	yes

Appendix 2. Random list of positive (yes) and negative (no) feedback. The feedback was the experimenter's statement that a particular card was or was not an example of the concept. See text for the order of administration of the different lists.

Anagram	Word Solution	Median Time in Seconds
beahc	beach	3.0
srgua	sugar	83.0
taibh	habit	25.0
tanog	tango	45.0
euohs	house	6.0
obrac	cobra	50.5
egujd	judge	3.0
hocar	roach	80.5
hicar	chair	57.0
rbscu	scrub	21.0
dpaot	adopt	42.0
reckl	clerk	91.5
ohtnm	month	13.0
ltifr	flirt	32.0
oapnr	apron	132.0

Appendix 3. Anagrams, word solutions, and median solution times as reported by Tresselt and Mayzner (1966). The anagrams are presented here in the order in which they were presented to all subjects.